

**From:** Rochlin, Kevin  
**Sent:** Thursday, May 08, 2014 10:32 AM  
**To:** Barbara Ritchie  
**Cc:** Douglas.Tanner; Greutert, Ed [USA]; Kelly Wright; Scott Miller; Stifelman, Marc; susanh@ida.net; Zavala, Bernie  
**Subject:** Comments on the Gamma Cap Framework  
**Attachments:** Final Gamma Cap Framework comments.docx

See attached document.

We should set up a conference call with the EPA and FMC teams to discuss. I would suggest 9:00 next Thursday which is our normal team call.

Kevin Rochlin



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OFFICE OF  
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May 8, 2014

Reply to  
Attn. of ECL-111

Ms. Barbara Ritchie  
FMC Corporation  
1735 Market Street  
Philadelphia, Pennsylvania 19103

**RE: Unilateral Administrative Order for Remedial Design and Remedial Action  
EPA Docket No. CERCLA 10-2013-0116**

**Comments on the Gamma Test Proposed Framework.**

Dear Ms. Ritchie:

EPA has reviewed the referenced document. Comments are enclosed. There will not be additional comments on this document from the Tribes or State.

The EPA has substantial concerns regarding the methods proposed. Methods developed and tested for the purpose of performing final status surveys on gamma caps at FMC must be able to demonstrate compliance with RAOs and meet the statistical requirements of the survey methods. Whether the correlation testing that is proposed can fulfill those objectives is not clear.

The proposal to use shielded (collimated) sodium iodide for surveys has potential as an alternative to the HPIC, since it would be shielded from some of the extraneous background and shine that is not related to residual Ra-226 gamma rays coming through the gamma cap. Evaluation of this technique requires (1) determination of background levels with sodium iodide, and (2) calibration of the sodium iodide for comparison with required detection sensitivities. The proposed Framework for additional testing addresses neither of these necessary elements. The development of field instrumentation for FMC final status gamma surveys is in the middle stages in the MARSSIM selection of field survey instrumentation (MARSSIM Figure 4.2) where the project needs to:

- Calculate required detection sensitivities.
- Evaluate instruments and techniques relative to required detection sensitivities.
- Determine whether required sensitivities can be achieved using direct measurements.

Gamma cap tests using HPIC techniques have so far failed to demonstrate that the HPIC has the required sensitivities to meet RAOs, given issues of shine and background. Based on background data, the minimum detection level of the HPIC system (in its current configuration at this site) is 100% of the RAO-based level of 2.8 uR/hr. By comparison, MARSSIM recommends minimum

Final Gamma Cap Framework comments.docx

detection levels of 10-50% of the action level, where possible. The HPIC technique appears to be marginal, at best, for use at this site in terms of its sensitivity and also its susceptibility to influence by shine from extraneous sources.

The use of correlations between HPIC and collimated sodium iodide data seems likely to involve significant uncertainties. Uncertainties in the correlations will need to be incorporated into the subsequent calculation of minimum detection levels for comparison to required detection sensitivities. It is not clear that the proposed correlations will lead to detection levels consistent with RAOs.

EPA has included with its comments a set of recommendations intended to help maximize the potential for the correlations to be useful. After FMC has reviewed the information provided, we should set up a conference call to discuss the information and a path forward.

Sincerely,



Kevin Rochlin,  
Project Manager

Enclosure

## **Technical Review Comments on the FMC OU Framework for Additional Test Gamma Cap Evaluation and Performance Verification Dated March 21, 2014**

Surveys with shielded (collimated) sodium iodide techniques offer a promising approach to dealing with the problem of extraneous gamma shine onsite. Furthermore, technical reports and examples from other sites indicate that collimated sodium iodide systems should have the detection capability needed to adequately verify gamma cap performance at FMC. The key to this capability is proper calibration of the sodium iodide systems. Like any other survey technique, the collimated sodium iodide systems will need to be calibrated and also evaluated to show that they have the necessary detection capabilities. Instrument-specific background levels will also need to be determined.

Based on the information provided, it is not possible to determine that the proposed framework, and any correlations, will be capable of providing results consistent with the data needs (e.g. calibrations, minimum detection levels) for use of the sodium iodide systems at the FMC OU.

### **General Comments:**

A key design objective for this testing should be to demonstrate that the collimated sodium iodide measurement technique is capable of meeting minimum detection levels consistent with RAOs at this site. EPA's Data Quality Objectives methodology should be followed. DQOs for the testing should consider the uses for the data, and the data needs for that use. DQOs include the minimum detection level that would be required of the collimated sodium iodide system in order to meet RAOs. In addition, the maximum allowable uncertainty in the correlations necessary to meet required minimum detection levels must be considered. The primary design question for the correlation test is: "How good do the correlations need to be to be useful to the collimated sodium iodide survey technique?"

The Framework must describe the minimum required instrument sensitivity and how the results of the testing will be used to evaluate the capabilities of the technique against those requirements.

1. The Framework must include the assessment of sitewide background using the collimated sodium iodide technique. Minimum detection levels depend on the assessment of background for the instrument technique. The standard deviation of background measurements is a key determinant of the minimum detection level. The limited baseline measurements specified for the test pad are probably not sufficient as a basis for evaluating sitewide background distributions. The location, number and method of background measurements to be obtained should be specified in a manner similar to that previously performed to obtain HPIC background data.
2. The uncertainties in correlations must be factored into calculations of minimum detection levels. If the minimum detectable counts for the collimated sodium

iodide, based on background variability, is 1000 counts per minute and the correlation of uR/hr with counts per minute is 1000 cpm per uR/hr, it would appear that the minimum detection level is 1 uR/hr. But if the uncertainty in the correlation is factored into the MDA calculation, the MDA in terms of uR/hr will be larger.

3. HPIC background variability does not appear to leave any room for consideration of correlation uncertainties. An important consideration of any measurement technique is that the minimum detectable level be sufficiently low to meet RAOs. To a large degree, minimum detectable levels are a function of the variability of background for the technique. Where correlations or correction factors are included in the calculation, their uncertainty should also be factored in. A potential issue at this site is that the variability of HPIC background data is already significant. Adding to that the uncertainty associated with empirical correlations could make it difficult for calculated minimum detection levels to achieve RAOs.

Any correlations developed must include propagation of uncertainties and upper and lower confidence bounds for use in assessing minimum detectable activities and other instrument-related metrics. In order to meet RAOs, survey methods (including correlations) used for the final status survey must have minimum detection capability at least equivalent to 2.8 uR/hr (corresponding to 1E-4 risk). Based on previous background HPIC data (14.6 uR/hr with SD = 0.6 uR/hr), and using MARSSIM estimates for minimum detectable activity (4.65 x background SD), it appears that the minimum detectable level for HPIC measurements was barely adequate to meet 2.8 uR/hr during the previous testing. By comparison, MARSSIM recommends minimum detection levels of 10-50% of the action level, where possible. The HPIC technique appears to be marginal, at best, for use at this site in terms of its sensitivity and also its susceptibility to influence by shine from extraneous sources.

Since correlating these measurements will only add uncertainty and therefore increase the minimum detection level, it does not appear that the correlations described will provide an adequate basis for surveys.

4. Characterization of the Ra-226 content of the slag pad could be used to calibrate the collimated sodium iodide system in terms of counts per minute per pCi/g Ra-226. Instrument calibrations are typically performed against known or well-characterized standards and have limited uncertainties associated. Since the proposed testing includes laboratory analysis of Ra-226 content in the slag pad, there is an opportunity to calibrate the collimated sodium iodide system response in terms of pCi/g Ra-226. The collimated sodium iodide system could then be used to survey the cap performance against the equivalent criterion of 3.8 pCi/g



Ra-226 above background, which is equivalent to the 2.8 uR/hr above background RAO.

5. Calculated literature calibrations could be used to convert collimated sodium iodide response from counts per minute to uR/hr. Sodium iodide system sensitivity data is provided by the manufacturer, but typically not to Ra-226 gamma energies. Methods and data are available in literature (e.g. NUREG-1507) which may be helpful in evaluating sodium iodide response to Ra-226 in terms of counts per minute per uR/hr. The nominal value provided in this document is 760 cpm/uR/hr for a 2x2 inch sodium iodide detector in response to Ra-226 in equilibrium with decay products.
6. The Framework could consider calibration of the collimated sodium iodide system as an alternative to the proposed correlations. Consideration should be given to calibrating the shielded sodium iodide detectors using standard methods such as comparison to known sources or concentrations, or as performed by a laboratory with appropriate capabilities. As an example, direct calibrations of HPIC systems have been performed by laboratories using Ra-226 sources. Test facilities with known Ra-226 concentrations are available which could be used to calibrate sodium iodide response to risk-based Ra-226 concentrations. Calibrations of this sort serve to limit associated uncertainties and could help ensure that minimum detection levels consistent with RAOs can be achieved.
7. The Framework could consider the use of highly sensitive High Purity Germanium systems. High Purity Germanium detectors could be used to accurately characterize Ra-226 soil concentrations as a calibration basis for similarly-collimated sodium iodide detectors. These systems could also be considered as stand-alone survey tools capable of measuring risk-based equivalent Ra-226 concentrations well below RAO levels.
8. Data analysis could include determination of background-subtracted counts per minute per uR/hr from Ra-226. The measurements performed on the uncapped slag pad potentially could be used to determine something similar to a calibration factor for the collimated sodium iodide in terms of counts per minute per HPIC uR/hr. Subtracting background levels from the response of each instrument would provide its response specific to Ra-226 and decay products. The ratio of these results could provide a calibration with relatively low uncertainty that should be evaluated as an alternative to the proposed correlations.
9. An alternative to using collimated sodium iodide systems to solve the problem with shine could be to correct the HPIC measurements to cut out the shine component. Although this method is somewhat more complicated than the



original plans for HPIC measurements, it could in principle support the use of the HPIC for final status surveys as originally intended. If this approach is considered worth evaluating, tests could be incorporated into the planned testing framework for that purpose.

The HPIC instrument response at FMC can be thought of as including (1) radiation from the ground and (2) everything else including cosmic radiation and shine. The cosmic and shine components could be excluded from the HPIC measurements by taking two HPIC measurements (one as usual, and one shielded), and employing a version of the “shadow shield” method used by DOE HASL to calibrate PIC instruments. The shielded HPIC measurement would be made with a shield placed below the HPIC to shield any sources from the ground within a field of view of the HPIC. This shielded measurement includes both cosmic contributions and any shine and would represent all sources except those from the ground. Subtracting it from the unshielded HPIC (total all sources) therefore gives a measure of the uR/hr from the ground in the field of view of the instrument. The “uR/hr from the ground” thus calculated includes both Ra-226 and background levels of other radionuclides. It could be evaluated against the risk-based RAO criterion of 2.8 uR/hr above background by subtracting the “uR/hr from the ground” obtained in the same way but during the determinations of background in the background area.

#### Recommendations Specific to Correlation Efforts:

It is not clear that the correlations described will have uncertainties limited enough to make them useful. Nonetheless, the following recommendations are suggested to improve any correlations. Improved correlations would help reduce overall uncertainties.

1. The Contaminant of Concern is Ra-226 and the radiations of interest are those from Ra-226 and its decay products. The best correlations would be between the Ra-226 response of the HPIC and the Ra-226 response of the collimated sodium iodide. The way to isolate the Ra-226 response is to subtract background from the data and correlate the net instrument responses.
2. Correlations should be obtained in the same configuration and at the same height for all instruments where practical. Where possible the field of view of the two instruments being correlated should be similar. Background subtraction methods should be considered to eliminate contributions to instrument response that are not correlated.
3. Correlations between instrument responses are best obtained when exposing the instruments to the same source using the same configuration. The HPIC and sodium iodide measurements are to be made at different heights above ground



surface. Better correlations would be obtained by exposing both detectors to the same fields in the same configurations. Since the intent is to use the sodium iodide in place of the HPIC during verification surveys, the sodium iodide should be used at the same 1 meter height as called for by the gamma RAO.

4. The methods proposed seek to obtain correlations between measurements that are largely unrelated. The contaminant of concern for this site is Ra-226 above background and its gamma emissions. The other influences on instrument response include cosmic radiation, gamma shine, and terrestrial radiation. None of these are related to Ra-226 gamma levels above background. Substantial uncertainties in any correlations may result and limit the usefulness of those correlations. The most useful correlations would be those made directly between sodium iodide response to Ra-226 above background and the HPIC response to Ra-226 above background. Background subtraction and corrections for shine and cosmic influences should be considered to refine the gross data from the instruments and improve any correlations.

To illustrate the difficulties in trying to correlate unrelated measurements, note that for background data the ratio of cpm per uR/hr is either 1000 (for unshielded sodium iodide vs HPIC), or 273 (for collimated sodium iodide vs HPIC) or 425 (for collimated sodium iodide vs HPIC with cosmic component subtracted).

5. Various correlations may be possible from the data obtained. It is not clear whether correlations will be made using shielded sodium iodide measurements with background subtracted. This data may provide a useful basis for correlation since the shielding and background subtraction serve to isolate the Ra-226 contribution to total counts from extraneous sources. Correlations based on shielded sodium iodide measurements with background subtracted should be included. To be correlated with HPIC data, the HPIC data should likewise be corrected for background and other nonsite sources (e.g. cosmic radiation).

#### Specific Comments:

1. The framework for this testing must specify data needs for the testing and the quality of the data that will be needed in order to obtain successful correlations.
2. The Framework identifies the Western Undeveloped Area (WUA) as the location for testing. This is similar to the location where gamma shine was noted as a possible confounding influence on previous test measurements. It is not clear how the proposed effort intends to compensate for this potential interference.



3. Included in the framework is an effort to “Determine ratios of bare and collimated gamma count rates and assess their consistency.” It would be helpful to clarify the purpose and intent of this evaluation.
4. The minimum cover thickness to reach the RAO will be evaluated based on exposure rate measurements. This is the same method that was attempted previously in a similar location with unsatisfying results. It is not clear what provisions have been made to address the shine problem with exposure rate measurements in this location.
5. Any correlations developed must include propagation of uncertainties and upper and lower confidence bounds for use in assessing minimum detectable activities and other instrument-related metrics.
6. It is stated that “The collimated gamma count rate that is the predicted equivalent to the RAO will be used as the relevant performance measurement.” Whether or not this is true will need to be determined as part of the evaluation of this testing. That basis will need to take into account acceptable decision errors, minimum detectable activities, and uncertainties to be established.
7. The framework must provide anticipated minimum detectable activities for the instruments (HPIC and sodium iodide) and methods (shielded, unshielded, background subtracted, gross counts) to be used for correlation testing.
8. The framework must describe how the testing will be used to provide DQO outputs related to final status surveys, including minimum detectable activities.